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ACA Provisions Associated With Increase In Percentage Of Young Adult Women Initiating And Completing The HPV Vaccine

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Abstract

Affordable Care Act provisions implemented in 2010 required insurance plans to offer dependent coverage to people ages 19–25 and to provide targeted preventive services with zero cost sharing. These provisions both increased the percentage of young adults with any source of health insurance coverage and improved the generosity of coverage. We examined how these provisions affected use of the human papillomavirus (HPV) vaccine, which is among the most expensive of recommended vaccines, among young adult women. Using 2008–12 data from the National Health Interview Survey, we estimated that the 2010 policy implementation increased the likelihood of HPV vaccine initiation and completion by 7.7 and 5.8 percentage points, respectively, for women ages 19–25 relative to a control group of women age 18 or 26. These estimates translate to approximately 1.1 million young women initiating and 854,000 young women completing the vaccine series.

Human papillomavirus (HPV) is the most common sexually transmitted infection in the United States.[1] Although most of these infections resolve without treatment, low-risk types can cause genital warts, while persistent infection with high-risk types is a necessary cause of cervical cancer.[2] Cervical cancer incidence and mortality have decreased over time in the United States, largely as a result of improved screening practices (that is, Pap testing).[3] The quadrivalent and bivalent HPV vaccines, licensed in June 2006 and October 2009, respectively, provide a complementary preventive measure, protecting against two strains of HPV responsible for 70 percent of cervical cancers.[4,5]

Although the CDC recommends routine HPV vaccination for females ages 11–12 and catch-up vaccination for females ages 13–26,[4] vaccination rates remain low, particularly among adult women. Suboptimal vaccine initiation rates have been hypothesized to be related to insufficient knowledge about HPV or the vaccine,[6] absence of a provider recommendation,[6,7] vaccine cost,[8–10] or lack of insurance coverage.[6,11,12] It is preferred to vaccinate adolescent girls since they are less likely to have been exposed to HPV vaccine strains and there is evidence of a greater immune response to the vaccine in younger adolescent females.

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However, research indicates that the potential number of averted infections in women older than age eighteen is still substantial, making vaccination cost-effective for these women.[13]

In a 2010 survey, only 21 percent of women ages 19–26 reported ever having received the vaccine.[14] Insurance coverage may have a positive effect on vaccine uptake by increasing access to medical providers, which may increase awareness of HPV or the vaccine, and by lowering the out-of-pocket cost of the vaccine and vaccination services.[6,8,15,16] One study found that 30 percent of unvaccinated adult women were not willing to pay the full price of approximately $390 for the three recommended doses of the HPV vaccine but would choose to receive the vaccine if it were available for free or for a greatly reduced cost.[8]

Since few states required private health plans to cover vaccines for adults before the Affordable Care Act (ACA) was passed in 2010, even insured adult women might not have had coverage of the HPV vaccine, or coverage might have been subject to substantial cost sharing.[17] Although national data on insurance coverage of immunizations are difficult to obtain, an Institute of Medicine study using 2000 data found that about half of nonelderly adults did not have coverage of recommended vaccines because they were either uninsured or underinsured.[18] We therefore expected ACA provisions extending dependent coverage up to age 26 and broadening coverage of preventive care to have increased HPV vaccine uptake both because of increased insurance coverage and because of improved coverage of the HPV vaccine among the insured. The dependent coverage provision may have also led to increased parental involvement in medical care decisions or improved continuity of care.

Before 2010, young adults had the lowest rate of insurance coverage of any age group.[19] Recent estimates imply that the September 2010 implementation of the ACA dependent coverage provision increased the percentage of young adults with any source of health insurance coverage by approximately 7 percentage points.[20,21] Given that this age group accounts for about thirty million people in the United States, this increase is equivalent to about two million young adults gaining coverage as of the end of 2011.

In addition to the increase in the percentage of young adults with any source of health insurance coverage, implementation of ACA provisions in 2010 also likely increased the generosity of insurance coverage for two reasons. First, the dependent coverage provision may have encouraged young adults up to age 26 to switch from their own coverage to parental coverage, which maybe more generous.[21–23] Second, the ACA prevention provisions (also implemented in September 2010) required that all new or non-grandfathered insurance plans provide various preventive services, including the HPV vaccine, with zero cost sharing.[24] The prevention provisions of the ACA likely had the most substantial effect on vaccine coverage among adult women who had been ineligible for coverage under the federal Vaccines for Children Program, which provides vaccines to uninsured and underinsured females up to age nineteen.[25]

While general measures of health care use are usually a logical starting point in analyses of the effects of health insurance expansions, most young adults have few health problems. This fact may explain why previous studies have not found a positive effect of the dependent coverage provision on the percentage of young adults having at least one health care visit in

the past year[20,26] or the percentage having obtained a flu shot in the past year,[26] a service that is low cost and may be obtained without a physician office visit. The HPV vaccine, on the other hand, is a service with a high out-of-pocket cost that is recommended for young women in the age group targeted by the dependent coverage provision of the ACA. This makes the vaccine an especially strong example to consider in examining the effects of coverage provisions under the ACA. We estimated the combined effect of ACA provisions implemented in 2010 that both increased the percentage of young adults with any insurance coverage and improved the generosity of coverage on HPV vaccine receipt among adult women.

Study Data And Methods

DATA SOURCE

This study used annual 2008–12 data from the National Health Interview Survey (NHIS), a household survey of the US civilian noninstitutionalized population administered by the National Center for Health Statistics. Information was collected on each household member, with one adult within each household sampled to complete a more in-depth survey.[27] Unweighted 2008–12 response rates among adults in the sample ranged from 61 percent to 66 percent. Outcome variables of interest included reporting ever initiating (that is, having one or more vaccine doses) and completing (that is, having three vaccine doses) the HPV vaccine, awareness of HPV, and awareness of the HPV vaccine. We also analyzed the change in the percentage with any insurance coverage as a comparison to previous studies.[20,21] Our final sample consisted of 10,010 women ages 18–26 after we dropped 458 women who did not respond to HPV questions. Of the 10,010 women in the sample, 7,975 were ages 19–25 and 2,035 were age 18 or 26.

STATISTICAL ANALYSIS

Following previous research, we used a difference-in-differences approach to estimate the effect of policy implementation on each outcome for women targeted by the dependent coverage provision (ages 19–25) relative to women not directly targeted but close in age (age 18 or 26).[20–22,28] The use of this second group as a control group identified an effect of the 2010 ACA provisions separate from other changes around this time that may have also affected the likelihood of vaccine receipt.

We estimated linear regression models of each outcome as a function of whether the person was in the 19–25 age group; whether the interview date was on or after October 1, 2010;[29] and whether both of these conditions were met, which represented the difference-in-differences effect of policy implementation for people ages 19–25 relative to people age 18 or 26. All regressions controlled for time trends using year fixed effects, and demographics including fixed effects for single years of age, race/ethnicity, marital status, health status, region of residence, and an urban area indicator. Since birth cohort is determined by year and age, our specification provided flexible control for differences in exposure opportunities and acceptance of the vaccine by year of birth. All analyses used survey weights, and standard errors accounted for the complex design of the NHIS using Stata software, version 12.1.

While the dependent coverage provision only affected people ages 19–25, the prevention provisions may have also improved coverage of targeted preventive services including the HPV vaccine among people age 26. The prevention provisions should not have affected eighteen- year-olds since most private plans were required to provide the HPV vaccine to women younger than nineteen, and uninsured and underinsured eighteen-year-olds were eligible for the Vaccines for Children program both before and after policy implementation. If the prevention provisions had a positive effect on vaccine uptake among those age 26, then the estimated effect of policy implementation on vaccine uptake among those ages 19–25 relative to those age 18 or 26 could underestimate the true effect. Therefore, we also estimated the model using a control group of eighteen-year-olds only for comparison.

We obtained an estimate of the change in vaccine receipt as a result of improvements in coverage generosity (as opposed to any insurance coverage) by restricting our main specification to insured individuals and multiplying the resulting difference-in-differences estimate by the proportion of people ages 19–25 with insurance prior to policy implementation. This is a rough estimate since the propensity of newly insured young women to obtain the vaccine maybe greater or less than that of young women who would have been insured even in the absence of the ACA. If the newly insured are more (or less) likely to get the vaccine, our estimate of the proportion of the change in vaccine uptake as a result of improvements in coverage generosity will be somewhat over- (or under-) estimated. To gauge the degree of bias in this calculation, we compared observed characteristics of insured young women both before and after the introduction of the ACA provisions.We also considered different assumptions about the increase in vaccine uptake for the newly insured relative to those who would have been insured in the absence of the ACA, to obtain upper and lower bounds on the effect of improvements in coverage generosity. Details of how these bounds were calculated are available in the online Appendix.[30]

LIMITATIONS

This study had several limitations. First, the use of only eighteen- or twenty-six-year-old women as a control group was necessary because vaccine eligibility ends at age twenty-six and because NHIS data on outcomes are unavailable for those younger than age eighteen in some years.[4,26] However, it is unlikely that low power led us to reject effects of the policy on the control group since the point estimates (presented below) for people age 18 or 26 did not look at all similar to estimates for those ages 19–25.

Second, our measures of vaccine receipt did not distinguish vaccination during the past year from vaccination more than one year ago. However, changes in “ever having the vaccine” after compared to before policy implementation for those ages 19–25 relative to those age 18 or 26 should be equivalent to new vaccination receipt.

Third, vaccination status was self-reported. One study found that the sensitivity of self-reported HPV vaccine receipt was 91 percent and specificity was 76 percent, based on comparison with electronic medical records.[31]

Fourth, most states implemented some, usually more restrictive, form of dependent coverage prior to federal implementation. However, studies have found that these earlier policies had little effect on insurance status.[32,33]

Finally, we were not able to assess changes in vaccination among males, for whom the HPV vaccine is also recommended. Because the NHIS did not survey males about vaccination status until 2010, the same year the ACA provisions we studied were implemented, accounting for pre-policy implementation trends in vaccination would be difficult. Furthermore, the recommendation for routine use of the vaccine in males changed in 2011,[34] which would likely confound estimates of the effect of the ACA provisions on male vaccination.

Study Results

OUTCOMES AND TRENDS PRIOR TO POLICY IMPLEMENTATION

Even during the pre-implementation period, most women reported being aware of HPV and the vaccine—a result that did not differ significantly for those ages 19–25 compared with those age 18 or 26 (Exhibit 1). Among the former, approximately 79 percent and 75 percent reported HPV and HPV vaccine awareness, respectively. By contrast, a minority of women reported vaccine receipt. Women who were age 18 or 26 were more likely than those ages 19–25 to report vaccine receipt, although even among the former, fewer than 24 percent reported vaccine initiation before the policy was implemented. Those ages 19–25 and age 18 or 26 were similar in terms of control variables.

Although there appears to be a sharp increase in vaccine initiation among those age 18 between 2008 and 2009, reported initiation increased more slowly between 2009 and the third quarter of 2010, mirroring the trend for those ages 19–25 and age 26 (Exhibit 2). As described in the Appendix,[30] results of formal tests for differences in trends in vaccine initiation by age group during 2008–10 were insignificant.

REGRESSION RESULTS

Exhibit 3 shows regression estimates of the change in outcomes after policy implementation for the two groups, as well as difference-in-differences estimates comparing the change for those ages 19–25 relative to those age 18 or 26. Consistent with previous work,[21] we found that the 2010 ACA provisions were associated with a 7.4-percentage-point increase in the percentage of young adults with any insurance coverage. However, we found no statistically significant effect of policy implementation on rates of awareness of HPV or the vaccine.

In contrast to awareness, our results imply that women ages 19–25 were more likely to report vaccine receipt after compared to before the policies took effect. These results are consistent with visual inspection of the unadjusted increase in vaccine initiation among women in this age group at the time of policy implementation (Exhibit 2). We estimated that reported vaccine initiation increased by 7.7 percentage points ($p<0.01$) for this group relative to women age 18 or 26. This estimate represents an approximate 38 percent increase relative to the percentage of women ages 19–25 who reported receiving at least one dose of the vaccine during the first three quarters of 2010 (20 percent). Results for all covariates are

presented in the Appendix.[30] The effect on vaccine initiation (7.7 percentage points) was somewhat larger than the effect on vaccine completion (5.8 percentage points), which suggests that most but not all of new vaccine initiation resulted in vaccine completion. There was no statistically significant change in vaccine receipt after policy implementation among women age 18 or 26. Although not reported, analyses using alternative control groups of only eighteen-year-old or only twenty- six-year-old women produced results similar to those presented in Exhibit 3.

When limiting the analysis to insured women, we estimated that vaccine initiation increased by 8.6 percentage points ($p<0.01$) for those ages 19–25 relative to those age 18 or 26, as shown in the Appendix.[30] Since approximately 73.7 percent of women ages 19–26 were insured in the period before policy implementation (Exhibit 1), this method implied that about 6.3 percentage points of the effect of the policies on vaccine uptake may have been attributable to improvements in coverage generosity. Compared to the 7.7-percentage-point effect estimated for the full sample, this suggested that about 1.4 percentage points of the increase in HPV vaccine uptake after the third quarter of 2010 was attributable to the 7.4-percentage-point increase in having any insurance coverage.

Comparing the characteristics of insured women ages 19–25 before and after policy implementation, we found that women insured post-implementation were significantly less likely to be married and less likely to be in excellent health (Exhibit 4). Because self-reported health status has not been found to be correlated with HPV vaccine initiation but being unmarried is significantly and positively associated with initiation,[8] our results suggest that the newly insured may have had a higher propensity to initiate the HPV vaccine compared with those who would have been insured in the absence of the ACA. However, the difference in the percentage of insured women ages 19–25 who were married before and after policy implementation is less than 3 percentage points. Under alternative assumptions that vaccine uptake among the newly insured was half or double compared with those who would have been insured in the absence of the ACA, we estimated that approximately 7.1 and 5.0 percentage points, respectively, of the increase in vaccine initiationwas attributable to improvements in coverage generosity, with 0.6 and 2.7 percentage points, respectively, of the increase attributable to the increase in any insurance coverage. See the Appendix for further details of these calculations.[30]

Discussion

Because most women reported awareness of HPV and the vaccine prior to implementation of the ACA provisions, lack of awareness was unlikely to be a major contributor to low vaccination rates before 2010. Policy implementation also had no detectable effect on HPV or vaccine awareness, which makes it unlikely that changes in awareness contributed substantially to the estimated increase in HPV vaccination post-implementation.

We estimated that the likelihood of initiating and completing the HPV vaccine among women ages 19–25 relative to those age 18 or 26 increased by 7.7 and 5.8 percentage points, respectively, after compared to before policy implementation. These estimates imply that about 1.1 million additional women ages 19–25 initiated and 854,000 completed the

vaccine, respectively, given the size of this population. In contrast, we found no change in vaccine uptake trends before and after the fourth quarter of 2010 for the control group of women age 18 or 26.

Disentangling the effects of the increase in the percentage of young women with any insurance and improvements in coverage generosity is difficult, but it is unlikely that the 7-percentage-point increase in insurance coverage resulting from the dependent coverage provision alone could account for the majority of the estimated increase in the likelihood of HPV vaccine initiation and completion. Likewise, other research examining the dependent coverage provision has documented a 4-percentage-point decline in the percentage of young adults reporting delaying obtaining medical care because of cost,[21] a 4-percentage-point increase in self-reported excellent mental health,[20] and a 6-percentage-point increase in self-reported excellent physical health.[20] Improvements in the generosity of coverage as a result either of switching to parental insurance plans or of improved coverage of targeted preventive services is also likely to be an important factor underlying our results, as well as other estimates of the effect of the dependent coverage provision.

Many ACA provisions are targeted toward improving the quality of health insurance coverage in addition to expanding coverage, but most other work assessing the impact of the ACA refers only to effects of increases in the percentage with any insurance coverage. Precisely identifying effects of improvements in coverage generosity on access to care may be difficult since few surveys contain information on which health care services are covered under an individual's health insurance plan with details on required deductibles and copayments. Parsing out these effects may continue to be a challenging although important focus for research going forward.

Conclusion

The 2010 implementation of the ACA dependent coverage and prevention provisions was associated with a significant increase in the percentage of young adult women who had initiated and completed the HPV vaccine three-dose series. The cost of the vaccine ($390 or more for three doses) may have been a barrier to its use prior to 2010, even among insured women.[8] By increasing the percentage of young women with any source of insurance and decreasing the out-of-pocket cost of the vaccine among those who would have been insured in the absence of the ACA, implementation of the ACA provisions may have facilitated uptake of the HPV vaccine among adult women.

Increasing the percentage of adults that receive recommended vaccines and reducing infection with vaccine-preventable illnesses are federal health objectives.[35] While some recommended vaccines, such as the seasonal influenza vaccine, are available at a relatively low cost even to uninsured adults, others recommended to at-risk adults such as the meningococcal, pneumococcal, hepatitis A, and hepatitis B vaccines can cost substantially more. For example, the 2014 cost for an uninsured adult of obtaining a seasonal influenza vaccine was $32, compared with a cost of more than $200 for the hepatitis A vaccine at one large drugstore chain.[36] The dependent coverage and prevention provisions may have also

reduced the out-of-pocket costs of these vaccines (in addition to other targeted preventive services).

Preliminary evidence suggests that health insurance coverage among adults expanded during the first quarter of 2014 after additional ACA policies took effect, including the establishment of state health insurance exchanges with subsidized coverage related to income and Medicaid expansions in some states.[37] Most of those who gain health insurance will have access to recommended vaccines and evidence-based screening and counseling services specified in the prevention provisions at no cost. This has the potential to enhance the effects of increased insurance coverage on access to and use of recommended care.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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NOTES

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29. When we considered vaccine completion, this variable was replaced with an indicator equal to 1 for interview dates beginning April 1, 2011, since three doses ofthe vaccine are typically administered over a period of six months or longer.
30. To acccess the Appendix, click on the Appendix link in the box to the right of article online.

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Implementation of the ACA provisions may have facilitated uptake of the HPV vaccine among adult women.

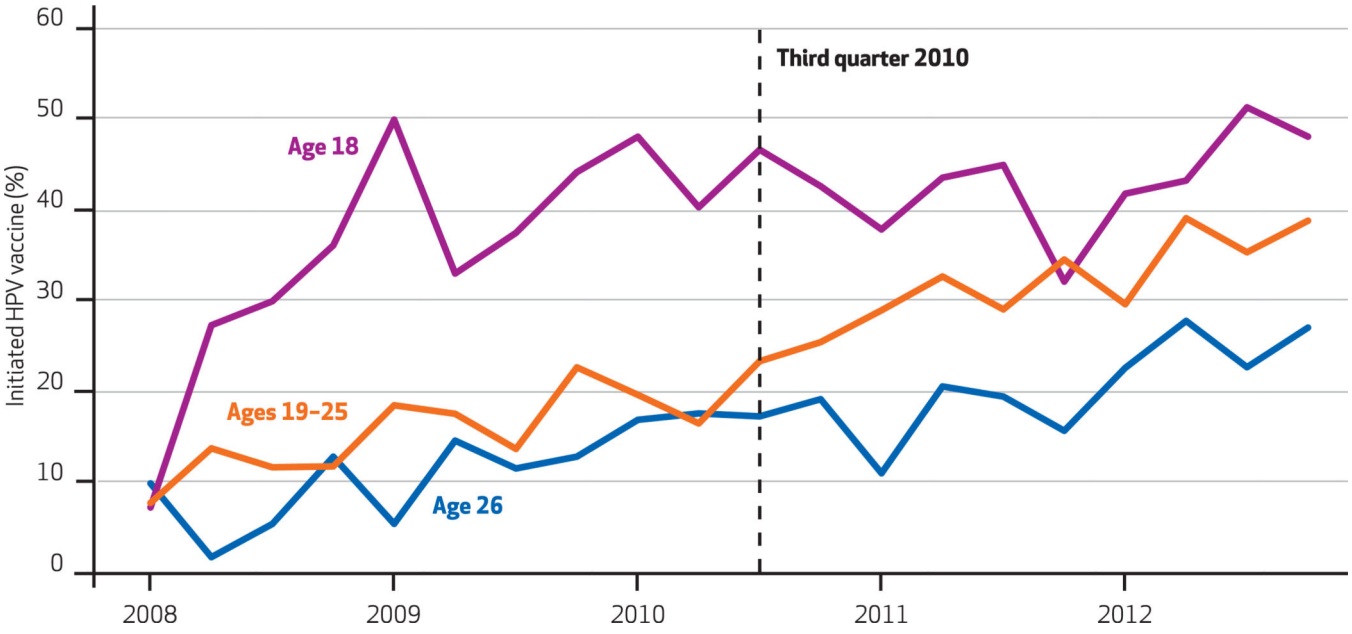

EXHIBIT 2. Human Papillomavirus(HPV)Vaccine Initiation Rates Among Women Before And After October 2010, By Quarter And Age Group

SOURCE Authors' analysis of data from the National Health Interview Survey (NHIS), 2008–12. **NOTES** The number of women ages 19–25 (orange line) who initiated the HPV vaccine in the fourth quarter of 2009 was computed by multiplying the 2009 population estimate for women in this age group by the estimated percentage who initiated the vaccine in the fourth quarter of 2009. Similarly, the number of women in this age group who initiated the HPV vaccine in the second quarter of 2011 was computed by multiplying the 2011 population estimate for women in this age group by the estimated percentage who initiated the vaccine in second quarter of 2011. Population estimates were obtained from the NHIS.

EXHIBIT 1

Characteristics Of The Study Sample Before October 2010: Women Ages 19–25 (Study Group) And Women Age 18 Or 26 (Control Group)

	Study: ages 19–25	Control: age 18 or 26
DEPENDENT VARIABLES		
Insurance coverage		
Any insurance coverage	73.69%	82.53%***
Awareness		
Heard of HPV	79.18%	78.58%
Heard of HPV vaccine	74.94	77.26
Vaccination status		
Vaccine initiation	15.87%	23.83%***
Vaccine completion	8.85	15.25***
INDEPENDENT VARIABLES		
Age (years)	22.02	22.12
Married	21.32%	22.68%
Race/ethnicity[a]		
Non-Hispanic white	60.68%	63.78%
Non-Hispanic black	15.87	14.25
Hispanic	17.29	16.87
Asian/other	6.16	5.11
Health status, self-reported[a]		
Excellent	42.56%	43.03%
Very good	33.25	33.23
Good or fair/poor	24.17	24.75

SOURCE Authors' analysis of data from the National Health Interview Survey, first quarter 2008–third quarter 2010. **NOTES** The sample size for the pre-policy implementation period included 3,814 women ages 19–25 and 1,004 women age 18 or 26. All figures are mean percentages, except for age, which is mean years of age. A person was considered to have completed the three-dose vaccine series if she reported receipt of three or more doses of the vaccine. Significance indicates a difference of the control group from the study group, based on t-tests. HPV is human papillomavirus.

[a]There were no significant associations between being ages 19–25 versus 18 or 26 and race or health status based on Pearson's chi-square test statistic corrected for survey design.

*** $p<0:01$

EXHIBIT 3

Change In Outcomes After October 2010 Compared To Before October 2010: Women Ages 19–25 (Study Group) And Women Age 18 Or 26 (Control Group)

	Change from before October 2010 to after October 2010 (percentage points)		Difference-in-differences estimate[a]
Dependent variable	**Ages 19–25[a]**	**Age 18 or 26[a]**	
INSURANCE COVERAGE			
Any insurance coverage	8.82***	1.43	7.40***
AWARENESS			
Heard of HPV	0.37	0.48	−0.12
Heard of HPV vaccine	2.39	0.64	1.75
VACCINATION STATUS			
Vaccine initiation	6.83**	−0.85	7.69***
Vaccine completion[b]	4.32*	−1.51	5.83**

SOURCE Authors' analysis of data from the National Health Interview Survey, 2008–12. **NOTES** Percentage-point changes were estimated using linear probability models. Sample size included 10,010 18–26-year-old women, including 7,975 19–25-year-olds and 2,035 18- or 26-year-olds. Controls included fixed effects for single years of age, race/ethnicity, marital status, health status, region of residence, an urban area indicator, and year fixed effects. HPV is human papillomavirus.

[a]The difference-in-differences estimate is the coefficient on the interaction between the binary variable indicating an interview date after policy implementation and the binary variable indicating that a person was in the group ages 19–25. The change in outcome for the group age 18 or 26 (control group) is estimated as the coefficient on the binary variable indicating an interview date after policy implementation. The change in outcome for the group ages 19–25 (study group) is estimated as the sum of these two coefficients.

[b]When vaccine completion is the outcome variable, the binary variable indicating an interview date after policy implementation was equal to 1 for interview dates after April 1, 2011, instead of October 1, 2010. A person was considered to have completed the three-dose vaccine series if she reported receipt of three or more doses of the vaccine.

*p<0:10

**p<0:05

***p<0:01

Exhibit 4

Characteristics Of Insured Women Ages 19–25, Before And After October 2010

Independent variable	Before October 2010	After October 2010
Age (years)	22.01	21.97
Married	21.29%	18.34%**
RACE/ETHNICITY[a]		
Non-Hispanic white	64.84%	66.00%
Non-Hispanic black	15.05	14.36
Hispanic	13.44	13.56
Asian/other	6.67	6.09
HEALTH STATUS, SELF-REPORTED[a]		
Excellent	45.87%	39.44%
Very good	32.98	35.41
Good or fair/poor	21.15	25.15

SOURCE Authors' analysis of data from the National Health Interview Survey, 2008–12. **NOTES** All estimates are mean percentages for insured women ages 19–25 included in the analysis sample. The sample includes 2,781 women interviewed before October 1, 2010, and 3,173 women interviewed after October 1, 2010. Significance indicates a difference for insured women ages 19–25 before versus after October 2010, based on *t*-tests.

[a]The association between an interview date after versus before October 1, 2010, and race was insignificant based on Pearson's chi-square test statistic corrected for survey design. The association between an interview date after versus before October 1, 2010, and health status was significant at the 1 percent level.

** $p<0:05$